Some Organic Contents of *Sesbania Sesban* Seed Oil

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**Abstract:** The seeds oil of *Sesbania sesban* was studied. The fatty acid composition and some vitamin constituents were analyzed using GC/MS and UV-VIS spectrophotometer. Results obtained from the fatty acid profile for both soxhlet and cold extraction revealed appreciable amount of linolenic acids (59.42% and 51.32%). The vitamin analysis revealed a significant amount of vitamin E (15.76mg/100g and 20.8mg/100g). Conclusively, *Sesbania sesban* seeds oil is a good source of essential fatty acids and vitamin E.

**Keywords:** *Sesbania sesban*, seeds, oil, GCMS, vitamins.

1. Introduction

*Sesbania sesban* is an erect, branched, a quick growing short-lived shrub tree up to 8m. It has a long history of use in India, grows in a wide range of soils from loose sands to heavy clays. It is widely distributed in tropical Asia and Africa up to an altitude of 1200m³ (Anonymous, 2003). Its leaves are 7.5 - 15cm long, fruits are 12 - 23cm long and 2.5 - 3.8mm in diameter and flowers are 1.2 - 1.5cm long. The raceme has 2-20 flowers which are yellow with purple or brown streaks on the corolla. Pods are sub cylindrical, straight or slightly curved up to 30cm long and 5mm wide containing 20-30 seeds (Rastogi and Mehrotra, 1995). The seeds and pods of *Sesbania sesban* are rich in almost all the essential nutrients needed by the livestocks (Arekemase *et al.*, 2013).
Oil is an important part of human nutrition despite the health risk problems associated with it, it still plays an important role in human body such as in hormone synthesis and regulations, controlling body temperature of which it acts as insulator. They are a major source of energy and provide essential lipid nutrients. Nevertheless, over-consumption of certain lipid components can be detrimental to our health, e.g. cholesterol and saturated fats. Linolenic acid has been assessed for its role in cardiovascular health. Clinical benefits have been seen in some, but not all studies. Still, a review in 2005 concluded that "The weight of the evidence favours recommendations for modest dietary consumption of linolenic acid (2 to 3 g per day) for the primary and secondary prevention of coronary heart disease" (Mozaffarian, 2005). Biodiesel can also be produced from the seeds oil of *Sesbania sesban* by in-situ transesterification. The biodiesel fraction from the oil content of this plant was found to be 29%, 63.75 % at 800°C and 300 rpm oscillations for 45 minutes and normal atmospheric pressure (Dalvi *et al*., 2009).

The aim of this work is to study the alternative source of monounsaturated and polyunsaturated fatty acids (MUFAs and PUFAs) from underutilized leguminous plant, basically *Sesbania sesban*.

2. Materials and Methods

2.1. Plant Collection

The plant was collected from National Research Institute for Chemical Technology, Basawa, Zaria in Sabon Gari L.G.A of Kaduna State and identified at herbarium, in the Department of Biological Sciences, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

2.2. Plant Preparation

The seeds were cleaned, sun-dried and grinded into fine powder using sterile mortar and pestle.

2.3. Soxhlet Extraction

The oil was extracted by soxhlet extraction following the method described by the AOAC (1984).

2.4. Cold Extraction

Exactly 100g of finely grounded sample was dissolved in 300ml of n-hexane in 1000ml conical flask and it was covered with aluminum paper foil for 48hours with continuous shaking on a shaker. After which it was filtered, the filtrate was concentrated on a water bath at 40°C and the oil was obtained.
2.5. Fatty Acids Determination

2.5.1. Sample preparation for GC-MS

The oils extracted were methylated. Exactly 0.2g of each sample was weighed into separate conical flask. About 6ml of methanolic sodium hydroxide (NaOH) was added to each flask containing the samples and reflux for 30mins. Followed by addition of 10ml of methanolic HCl to each flask and then reflux for another 10minutes. Precisely 10ml of n-hexane was also added to each flask for 2minutes and then cooled. Lastly, 10ml of distilled water was added to each flask and the oil was separated using separating funnel. The oil obtained was subjected to GC-MS analysis.

2.5.2. Gas chromatography and mass spectrophotometer

The methylated oils were further subjected to gas chromatography and mass spectrophotometer. A GC-MS QP 2010 PLUS (Shidmazu, Japan) was used for the instrumental analysis. A RTX-5ms column (5% diphenyl, 95% dimethylpolysiloxane stationary phase), 30m x 0.25mm i.d x 0.25µm film thickness (Restek, USA) was used. The column temperature program is as follows: 70°C raised at 10°C/min to 240°C, hold for 4min, raised at 15°C/min to 280°C, hold for 5min, with an injection temperature of 250°C. The carrier gas used was helium with a flow rate of 40.8mL/min. The detector was a quadrupole mass spectrometer (MS) with EI ionization at 70eV in full scan mode (Adams et al., 2001).

3. Results and Discussion

Table 1 shows the results for the fatty acid profile of the oil extracted from the seed of *Sesbania sesban* using soxhlet extraction procedure. The seed oil contained 28.66% saturated fatty acids (SFAs), 9.59% monounsaturated fatty acids (MUFAs) and 61.75% polyunsaturated fatty acids (PUFAs). Stearic acid and palmitic acid were the major saturated fatty acids present in the seed oil.

The results shown in table 2 reveals the fatty acids composition of the seed oil from cold extraction. The seed oil also contained 31.31% saturated fatty acids (SFAs), 14.75% monounsaturated fatty acids (MUFAs) and 53.96% polyunsaturated fatty acids (PUFAs). Oleic acid was the only monounsaturated fatty acid present. Oleic acid (omega-9) is a monounsaturated fatty acid found in animal and vegetable oils. The oleic acids contents (9.59 and 14.75%) presented in tables 1 and 2 were lower compared to 55 - 80% reported for the oleic acid content of olive oil (the major source of oleic acid) (Rickman, 2004).

The saturated form of oleic acid is stearic acid (Keffler and McLean1935; Wikipedia 2004). The stearic acid contents (9.14 and 9.05%) were higher than the value (1.5%) reported for the stearic acid content of *Cassia tora* seed oil (Ayodele et al., 2004). In epidemiological and clinical studies, stearic acid was associated with lowered LDL cholesterol in comparison with other saturated fatty acids.
acids (Hunter et al., 2010). Palmitic acid is the most common fatty acid found in animals, plants and microorganisms (Gunstone et al., 2007). Consumption of palmitic acid increases the risk for cardiovascular diseases (WHO, 2003). Although the percentage of palmitic acid contents obtained in this study were lower than the essential fatty acids. The palmitic acids content (16.60 and 19.15%) obtained in this research work were lower than the palmitic acid content (26.19%) of Brachystegia eurycoma seeds oil (Ajayi et al., 2006).

Table 1: Fatty acids composition of Sesbania sesban seeds oil (soxhlet extraction)

<table>
<thead>
<tr>
<th>Common name</th>
<th>Systemic name</th>
<th>Shorthand representation</th>
<th>Percentage composition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myristic acid</td>
<td>Tetradecanoic acid</td>
<td>14:0</td>
<td>0.23</td>
</tr>
<tr>
<td>Palmitic acid</td>
<td>Hexadecanoic acid</td>
<td>16:0</td>
<td>16.60</td>
</tr>
<tr>
<td>Oleic acid</td>
<td>9-octadecenoic acid</td>
<td>18:1;9</td>
<td>9.59</td>
</tr>
<tr>
<td>Linolenic acid</td>
<td>Cis-9,12,15-</td>
<td>18:3;9,12,15</td>
<td>59.42</td>
</tr>
<tr>
<td></td>
<td>octadecatrienoic acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stearic acid</td>
<td>n-octadecanoic acid</td>
<td>18:0</td>
<td>9.14</td>
</tr>
<tr>
<td>Arachidic acid</td>
<td>n-Cicosanoic acid</td>
<td>20:0</td>
<td>1.91</td>
</tr>
<tr>
<td>Linoleic acid</td>
<td>Cis-9,12-</td>
<td>18:2;9,12</td>
<td>2.02</td>
</tr>
<tr>
<td></td>
<td>octadecadienoic acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behenic acid</td>
<td>n-Docosanoic acid</td>
<td>22:0</td>
<td>0.78</td>
</tr>
<tr>
<td>Arachidonic acid</td>
<td>Eicosatetraenoic acid</td>
<td></td>
<td>0.31</td>
</tr>
</tbody>
</table>

Table 2: Fatty acids composition of Sesbania sesban seeds oil (Cold extraction)

<table>
<thead>
<tr>
<th>Common name</th>
<th>Systematic name</th>
<th>Shorthand representation</th>
<th>Percentage composition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmitic acid</td>
<td>Hexadecanoic acid</td>
<td>16:0</td>
<td>19.15</td>
</tr>
<tr>
<td>Oleic acid</td>
<td>9-octadecenoic acid</td>
<td>18:1;9</td>
<td>14.75</td>
</tr>
<tr>
<td>Linolenic acid</td>
<td>Cis-9,12,15-</td>
<td>18:3;9,12,15</td>
<td>51.32</td>
</tr>
<tr>
<td></td>
<td>octadecatrienoic acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stearic acid</td>
<td>Octadecanoic acid</td>
<td>18:0</td>
<td>9.05</td>
</tr>
<tr>
<td>Behenic acid</td>
<td>n-Docosanoic acid</td>
<td>22:0</td>
<td>3.10</td>
</tr>
<tr>
<td>Linoleic acid</td>
<td>Cis-9,12-octadienoic</td>
<td>18:2;9,12</td>
<td>2.64</td>
</tr>
<tr>
<td></td>
<td>acid</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The arachidonic acid content was revealed in table 1 (from soxhlet extraction) and was not present in table 2 (cold extraction). Arachidonic acid is a polyunsaturated fatty acid present in the phospholipids (especially phosphatidylethanolamine, phosphatidylcholine and (phosphatidylinositides) of membranes of the body’s cells and is also abundant in the brain and liver. Arachidonic acid is also one of the most abundant fatty acid in the brain, and is present in similar quantities to docosahexaenoic acid (DHA). The two account for approximately 20% of its fatty acid content (Crawford and Sinclair 1971). Like DHA, neurological health is reliant upon sufficient levels of arachidonic acid. Among other things, arachidonic acid helps to maintain hippocampal cell membrane fluidity (Wang et al., 2006). It also helps to protect the brain from oxidative stress by activating peroxisome proliferator (Fukaya et al., 2007).

A major consequence of linolenic acid deficiency is that its chief synthetic end product, docosahexaenoic acid, is not adequately produced (Neuringer et al., 1984). Docosahexaenoic acid is a major component of the phospholipid membranes of the brain and retina, its deficiency in these organs then leads to abnormal function (Neuringer et al., 1986). Although the percentage of the linolenic acid content obtained in this study was reasonable enough to alleviate problems associated with linolenic acid deficiencies. The content of linolenic acid obtained in this study agrees with literature that Sesbania sesban seed oil is a good source of linolenic acid (Hossa in and Becker, 2001). Linolenic acid deficiency is accentuated when there is simultaneously a high content of linoleic acid in the diet, which tends to inhibit the synthesis of docosahexaenoic acid from linolenic acid. In this case, the linoleic acid content (2.08 and 2.64) obtained in this study were lower than the linolenic acids (59.42 and 51.32) composition. The iodine value 143.1 reported for Sesbania sesban seed oil by Dambatt and Ogah (2000) was in accordance with the value of essential fatty acids obtained in this study. This implies the higher the iodine value of oil the higher the degree of unsaturation.

Table 3 revealed the results obtained for some vitamins from both soxhlet and cold extraction. The constituents of vitamin E 15.76mg/100g and 20.8mg/100g revealed in Table III might block the formation of carcinogenic nitrosamines formed in the stomach from nitrites in foods and protect against cancer by enhancing immune functions (Kirsh et al., 2006). It is also pivotal in the proper function of the brain. It protects the myelin sheaths that surround neurons in the brain. This can help prevent degeneration during the normal aging process. It may also help prevent Alzheimer's disease. (Danna, 2011). Vitamin E contents obtained from this study were lower compared to the value obtained for Sesbania gradifloral oil, soybean oil, sunflower and corn oil (Huma et al., 2012). The vitamin E contents obtained from both soxhlet and cold extraction (23.69IU and 31.20IU) were above the recommended dietary allowances (RDAs) 22.4IU and 22.4IU for both male and female (IMFNB,2000). This shows that Sesbania sesban is an excellent source of vitamin E.
Table 3: Vitamin contents of *Sesbania sesban* seed oil

<table>
<thead>
<tr>
<th>Vitamins</th>
<th>Soxhlet</th>
<th>Cold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin E</td>
<td>15.76mg/100g</td>
<td>20.8mg/100g</td>
</tr>
<tr>
<td>Provitamin A</td>
<td>3.98mg/100g</td>
<td>4.63mg/100g</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>1.48mg/l</td>
<td>2.40mg/l</td>
</tr>
</tbody>
</table>

Vitamin A is a group of nutritionally unsaturated hydrocarbons, which include retinol, retinal, retinoic acid, and several provitamin A carotenoids, among which beta-carotene is the most important (Fennema, 2008). Vitamin A has multiple functions, it is important for growth and development, for the maintenance of the immune system and good vision (Tanumihardjo, 2011). The results obtained for the vitamins in cold extraction was higher than that of soxhlet extraction, this may be due to heat involved during soxhlet extraction of the oil as some vitamins are volatile.

4. Conclusion

From this study, it is clear that *Sesbania sesban* seed oil is a good source of linolenic acid and vitamin E that may be useful in food and cosmetics industries.

References


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